REMARKS

The amendment does not involve new matter. The changes to amended claims from the previous version to the rewritten version are shown in Appendix A, with brackets for deleted matter and underlines for added matter. Claim 14 has been amended to add a limitation supported by Figure 4. Claim 49 has been amended to correct a typographical error. New claim 79 is patterned after claim 10. New claims 80-88 are patterned after claims 30-37 and 57 respectively, and are fully supported by the specification.

As noted in the Amendment mailed April 12, 2002, claim 58 was added by a Preliminary Amendment mailed on June 6, 2001, but was not addressed in the oral restriction or the October 12, 2001 Office Action. Claim 58 has still not been addressed. It is believed that claim 58 is properly part of Group I. If the Examiner cannot find the file copy of the Preliminary Amendment he is invited to telephone the below signed attorney and request a faxed copy.

The Office Action Summary indicates that claim 30 is allowed. The text of the Office Action does not further address claim 30. It is believed that claim 30 was inadvertently left out of the listing of allowed claims in Paragraph 15 of the Office Action. The allowance of claims 30-37 and 57, and allowability of claims 28 and 29, is noted with appreciation.

The drawings were objected to, and claims 49-51 was rejected in the outstanding Office Action under 35 U.S.C. §112, first paragraph because there was no disclosure, in the drawings or specification, of a motor made with a shaft having a magnet connected thereto as called for in claim 49. Claim 49 had a typographical error, which has now been corrected. Claims 49-51 are now enabled and represented by the drawings.

Claims 1, 4-10, 18, 20-24, 52, 56 and 59-78 were rejected in the outstanding Office Action under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,241,229 (Katakura) in view of U. S. Patent No. 5,459,190 (Nakamura) and U.S. Patent No. 4,390,649 (Aharoni). This rejection is respectfully traversed. Katakura discloses a magnetic disc drive motor. The disc drive includes a cylindrical holder 12 projecting upward from the central area of a motor frame 11. A stator core 18 is rigidly fitted to the outer periphery of the holder 12. The space between the stator core 18 and the motor frame 11 is filled with a very hard epoxy resin material 22 injected into the base portion

of the holder 12. The Office Action states that the material 22 is "injection molded". This statement is traversed. While Katakura states that the material is injected, it does not state that it is "injection molded." The term "injection molded" has acquired a distinct meaning in the art. It implies that a molten material is injected into a closed part cavity under high pressure, and allowed to solidify. A person of ordinary skill in the art would not consider the injection of epoxy in Katakura as being "injection molded."

Claims 1, 10, 59, 60, 62, 63, 66 and 74 require a stator assembly with a core having poles and windings around the poles, with an injection molded thermoplastic material substantially encapsulating the windings. The resin used in Katakura is not a thermoplastic material. Epoxy resins are thermosetting, not thermoplastic. The Office Action takes the position that it would have been obvious to substitute the thermoplastic material of Nakamura or Aharoni for the thermosetting material of Katakura. This position is traversed. The motor in Katakura is for a magnetic disc drive. The materials of Nakamura and Aharoni would not be injection molded to encapsulate windings of a motor used in the magnetic disc drive of Katakura. First, the Office Action states that Nakamura discloses a magnetic drive. No such disclosure could be found. The only example of a specific motor disclosed in Nakamura is a submersible canned motor, such as would be used on a pump. Second, the material of Nakamura includes zircon, which is a silicon based material. (See Appendix B.) It is well known that silicon based materials are not to be used in magnetic disc drives. (See Col. 2, line 3 of U.S. Patent No. 6,433,957, Appendix C). Thus, the material of Nakamura would not be substituted and injection molded to make the motor of Katakura. Third, the material of Aharoni has a high degree of shrinkage in the cross-flow direction. The materials with a modulus of elasticity of between 1.00 and 1.38 million psi reported in col. 8 Table VII of Aharoni are PET, containing over 20% fiberglass. It is well known that injection molded PET materials with such high levels of glass fibers have a shrinkage rate in the cross-flow direction that is in order of magnitude grater than the shrinkage in the flow direction. For example, attached as Appendices D and E are specification sheets for 30% and 20% glass filed PET materials. The shrinkage in Rynite® 530 PET, with 30% glass fibers, is 3 to 4 times greater in the transverse direction as it is in the flow direction. (See Appendix D, page 3.) For Rynite® 520 PET with 20% glass fiber, the shrinkage in the

transverse direction is also about 3 to 4 times greater than the shrinkage in the flow direction. (See Appendix E, page 3.)

A PET material with over 20% glass fiber, such as disclosed in Aharoni, would therefore not be appropriate for an injection molding process of a part requiring dimensional precision like the motor of Katakura, as it would warp when it cooled. In view of these reasons, it is believed that a person of ordinary skill in the art would not make the combinations relied upon as the basis for the rejection. Therefore claims 1, 10, 59, 60, 62, 63, 66 and 74 and claims 4-9, 18, 20-24, 52, 56, 61, 64-65, 67-73 and 75-78 dependent thereon, are patentable over Katakura, Nakamura and Aharoni. Further, claim 4 requires that the stator assembly is rigidly attached to the baseplate by being rigidly attached to a support member secured to the baseplate. In Katakura the holder 12 is an integral part of the baseplate rather than a separate support member secured to the baseplate. Claim 4 thus further differentiates over Katakura.

Claims 60 and 61 are further patentable in requiring a metal plate substantially encapsulated in the stiff thermoplastic material. Neither Katakura, Nakamura nor Aharoni discloses such an encapsulated metal plate.

Claim 10 further requires the stator assembly to be spaced from the baseplate and not be in direct contact with each other, and that a thermoplastic material be secured to the baseplate and substantially encapsulates the stator windings, the thermoplastic material joining the stator assembly to the baseplate and filling in the space between the stator assembly and the baseplate. The Office Action takes the position that in Katakura the stator assembly is spaced from the baseplate. This is not correct. As noted above, the holder 12 is a part of the baseplate. Thus in Katakura the stator assembly is in direct contact with the baseplate. In this area of contact, the epoxy resin does not fill in because there is no space between the stator assembly and the baseplate. Claims 63 and 66 state this same concept slightly differently, requiring that the stator assembly is connected to the baseplate only through the thermoplastic material. Claims 10, 63 and 66, and claims 18, 20-24, 56, 64 and 67-73 dependent thereon, are further patentable over Katakura.

Claim 56 is directed to a hard drive including the motor of claim 10. In view of the deleterious effects of silicon on hard drives, claim 56 is further patentable over the combination of references including Nakamura.

Claims 73, 75 and 77 require a modular of elasticity of at least 2,000,000 psi at 25°C. Claims 76 and 78 require a modular of elasticity of at least 3,000,000 psi at 25°C. The materials of Aharoni are disclosed as only having a maximum modular of elasticity well below 2,000,000 psi. Claims 73 and 75-78 are therefore further patentable over the cited references.

In the outstanding Office Action claims 1, 4-10, 18, 19-24, 52, 54-56 and 59-78 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,774,974 (Dunfield '947). This rejection is also respectfully traversed. Dunfield '974, like Katakura, discloses a motor for a disc drive. The Office Action gives the same logic for this rejection as for the rejection based on Katakura, namely that it would have been obvious to substitute the thermoplastic materials of Nakamura and Aharoni for the adhesive 78 used to cover the stator windings in Dunfield '974. As noted above, a person of ordinary skill in the art would not have wanted to use the thermoplastic materials of Nakamura or Aharoni in making the hard disc drive motor of Dunfield. Thus the reasons claims 1, 10, 59, 60, 62, 63, 66 and 74, and claims dependent thereon, are patentable over Katakura, Nakamura and Aharoni are also applicable to Dunfield '974, Nakamura and Aharoni.

In the outstanding Office Action claims 3, 13 and 53 were rejected under 35 U.S.C. §103(a) as unpatentable over Katakura or Dunfield '974 in view of Nakamura and Aharoni and further in view of U.S. Patent No. 5,694,268 (Dunfield '268). This rejection is respectfully traversed. Claim 3 is dependent on claim 1. Claims 13 and 53 are dependent on claim 10. As noted above, claims 1 and 10 are patentable over the primary references. Dunfield '268 also discloses a disc drive spindle motor. Thus, for the reasons discussed above, a person of ordinary skill in the prior art would not have used the materials of Nakamura or on Aharoni in the motor of Dunfield '268. Thus the references would not have been combined as suggested in the Office Action, and claims 3, 13 and 53 are patentable over the cited reference.

Claims 11, 12, 14, 16 and 17 were rejected under 35 U.S.C. §103(a) as unpatentable over Katakura or Dunfield '974 in view of Nakamura and Aharoni further in view of U.S. Patent No. 5,986,365 (Kuwert). Claims 11, 12, 14, 16 and 17 are all ultimately dependent on claim 10. As noted above, claim 10 is patentable over the primary references. Kuwert does not disclose a motor as called for in claim 10,

because claim 10 requires the baseplate and stator assembly to not be in direct contact with one another, and in Kuwert the laminations of the stator are directly in contact with the base. Thus claim 10, and claims 11, 12, 14, 16 and 17 dependent thereon are patentable over the cited reference.

In addition, claim 14 has been amended to specify that bearings used to make the hub rotate are directly connected to the ferrule. In Kuwert, the yoke 6 is not directly connected to the bearing. (The outer bearing case surrounding the shaft of Kuwert is not a ferrule.) Thus claim 12, and claims 16 and 17 dependent thereon are further patentable over the cited references.

Claims 14-17 were rejected in the outstanding Office Action under 35 U.S.C. §103(c) as being unpatentable over Katakura or Dunfield '974 in view of Nakamura and Aharoni further in view of U. S. Patent 5,325,004 (Mori). The rejection is respectfully traversed. As noted above, claim 14 requires the bearings to be directly connected to the ferrule. In Mori a bushing 130 is interposed between the bottom bearing 132 and the yoke 122. Thus claim 14, and claims 15-17 dependent thereon are patentable over the cited reference.

Claims 49-51 were rejected in the outstanding Office Action under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,195,225 (Pabst) in view of Nakamura. This rejection is also respectfully traversed. Pabst is like Katakura in that it discloses a motor used in a disk storage device. Since the thermoplastic of Nakamura includes silicon, and silicon is known to be undesirable in a hard drive device, a person of ordinary skill in the art would not have used the Nakamura thermoplastic to make the motor of Pabst. Claims 49-51 are thus patentable over Pabst in view of Nakamura.

Since each of the rejections have been overcome, the case is in condition for allowance. An early notice to that effect is respectfully requested.

Respectfully submitted,

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Dated: December 2, 2002

APPENDIX A

Changes to the claims are as follows:

14. (Amended) The spindle motor of claim 10 further comprising upper and lower bearings and wherein the hub comprises an outer member having an inside aperture and a ferrule fixed inside said aperture and connected directly to the bearings.

49. (Amended) A spindle motor comprising:

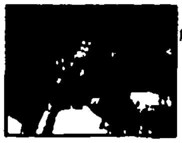
a) a baseplate;

b) a shaft supported by said baseplate;

c) a coreless stator assembly comprising windings encapsulated in a thermoplastic material; and

d) a hub rotatably supported on said shaft, said [shaft] hub having a magnet connected thereto in operable proximity to the stator assembly, the hub also including a flux return ring supported opposite the magnet so that the stator assembly is located between the flux return ring and the magnet.

APPENDIX B



THE MINERAL ZIRCON

- **Chemistry: $ZrSiO_4$, Zirconium Silicate**
- **Class:** Silicates
- **Subclass:** Nesosilicates
- **Uses: Gemstone and mineral specimens**
- Specimens

Zircons reputation has suffered of late due to the introduction of a diamond simulant. So for the record, zircon is **NOT** the same material as the artificial gem material **Cubic Zirconia** (or CZ). However with that in mind, zircon has been used as a diamond simulant both for innocent and nefarious reasons. Zircon resembles diamond in luster and fire and colorless zircons have been mistaken for diamonds by experienced jewelers. Zircon can make a very attractive and affordable gemstone. It is found in browns and greens but can be heat treated to beautiful blue and golden colors. Colorless material is produced in this way as well.

As a mineral specimen, zircon is uncommon in most rock shops because attractive specimens are rare. However, fine specimens of well shaped zircons are available and are in demand. The typical simple crystal of zircon is a tetragonal prism terminated with four sided pyramids at each end. The prism may be lacking and the crystal can look octahedral. More complex crystals have faces of a less steeply inclined prism that taper the terminations. Also a secondary prism may truncate the primary prism by cutting off its edges and producing an octagonal cross-section through the crystal. There is even an eight sided pyramid (actually a ditetragonal dipyramid) that may modify the four sided pyramids. As you can see, zircon crystals can go from a very simple crystal to a rather complexly faceted form.

PHYSICAL CHARACTERISTICS:

- **Color** is brown, red, yellow, green, blue, black, and colorless.
- **Luster** is adamantine.
- **Transparency** crystals are transparent to translucent.
- **Crystal System** tetragonal; 4/m 2/m 2/m
- **Crystal Habits**: dipyramidal and prismatic as discussed above.
- **Cleavage** indistinct in two directions, prismatic.
- **Fracture** is uneven
- **Hardness** is 7.5
- **Specific Gravity** is 4.6-4.7
- **Streak** white
- **Associated Minerals** albite, biotite, garnets, xenotime and monazite.
- **Other Characteristics:** is sometimes fluorescent and darker crystals may be radioactive due to impurities of rare earth elements. Also index of refraction is 1.92 - 2.01
- **Notable Occurances** Seiland, Norway; Pakistan; Russia; Bancroft and Sudbury, Ontario, Canada and New Jersey and Colorado, USA.
- **Best Field Indicators** are crystal habit, hardness, luster and density.

PHOTOCATALYTIC DEVICE FOR DISK DRIVE CONTAMINATION REDUCTION

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit and priority date of Provisional Application Serial No. 60/158,838, filed Oct. 12, 1999, in the name of Gregory I. Rudd and Karl H. Scheppers and entitled "Photocatalytic Device for Disc Drive Contamination Reduction."

FIELD OF THE INVENTION

The present invention relates generally to hard disk drives, and more particularly, to the reduction of contamination in hard disk drives.

BACKGROUND OF THE INVENTION

The internal environment of a modern computer hard disk drive (HDD) is critical to its function. The so-called head-disk interface (HDI) or area between the "head" which holds the reading and writing elements and the disk surface is very susceptible to contamination because the gap (height at which the head flies above the disk) is so small. The amount of data that can be stored on a disk is proportional to this gap. In present designs the gap is less than 30 nanometers (30×10^{-9} meters). To allow this, the disks also must be very smooth. Most present designs require the head to land on the disk when the disk drive is shut off. Upon start up, it must easily lift off the disk and leave no residue or damage behind.

Liquid or gaseous contamination can cause failure by several modes:

- The sticking of the head to the disk, usually due to vapor from liquids or low melting solids, is especially intractable in the disk drive industry.
- Corrosion of the disks can roughen the surface; corrosion of the heads can affect electrical performance.
- The fly height can be impacted by build-up of liquid or solid residue on the head, making data reading and writing unreliable.

Vapor concentrations as low as parts per billion of some common chemicals can cause catastrophic failure by one of these means. Changes in HDD technology such as lower flying heights, smoother disk surfaces, and lower power consumption by the spindle motor have all contributed to the greater sensitivity of new designs to these problems. Numerous schemes to minimize the hazard have been executed, and all have shortcomings as evidenced by the fact the HDI failures are a major limit to disk drive reliability.

One scheme common to almost all disk drives is to limit the use of materials inside the HDD known to "outgas" or generate vapors under operating conditions. This has been partly successful but notable problems are:

- No other industry and hence no piece part vendor has knowledge of the sensitivity of this issue in the HDD, so subcomponent manufacturers cannot always provide adequate materials.
- Testing methods are usually not as sensitive to contamination as is the HDI and small percentage failures can be very costly in terms of lost business.
- Increasing sensitivity of advanced designs has meant that previously acceptable materials can result in failure when used for new designs.
- Cost of well-controlled materials is much higher than less controlled materials. Market forces to reduce cost encourage the use of marginally acceptable materials (adhesives, plastics, and contaminated parts).
- Common "dirt" such as hydrocarbon oils and silicones must be removed by careful and expensive cleaning processes.
- Some necessary components are intrinsically vapor generating (e.g., bearing grease).

Another commonly used scheme has been to design the drive to leak with respect to the outside environment, ensuring that vapors from internal components are continuously diluted with fresh air. Obviously this scheme will fail if the outside environment, which is beyond the control of the HDD manufacturer, contains a harmful vapor or a material which in excess causes reliability problems (humidity is the best example).

A third commonly used scheme is to include a sorbent or adsorbent material, e.g., activated charcoal, inside the HDD. This is highly beneficial but demonstrably limited in its success. The sorbent is necessarily limited in its capacity for contaminants; it will eventually become saturated if continuously exposed. Also, the principal of sorption, whether physical or chemical, is reversible to varying degrees. Contaminants adsorbed at one temperature will be desorbed as the temperature rises. The present invention provides a solution to this and other problems as it comprises a device for purifying the internal atmosphere of an HDD.

SUMMARY OF THE INVENTION

The present invention comprises an assembly that includes a photocatalytic material and a device for activating photocatalytic material.

In accordance with one embodiment of the invention, an assembly of appropriate size and shape for mounting within a sealed or semi-sealed hard disk drive (HDD) is provided. More specifically, a photocatalytic surface is provided in close proximity or in contact with a light source which may be utilized as a means for activation.

The photocatalytic surface is preferably titanium dioxide (TiO_2); it may be other metal oxide catalysts that can be photochemically activated such as zinc oxide (ZnO).

The invention comprises an assembly that contains a photocatalytic material and a means for activating thereof. The assembly is of appropriate size and shape for mounting within a sealed or semisealed HDD. The catalytic activity of the photocatalytic material is engineered to cause chemical reactions of the vapor contaminants within the disk drive enclosure, which impinge on it, converting them to harmless gaseous species. The most important photocatalytic process for this purpose is photocatalytic oxidation.

This approach has many inherent advantages over the current state of the art. The catalytic surface would never be exhausted, as would an absorbent. Elevated temperature would not cause re-release of contaminants because they would be destroyed. The HDD could be almost or entirely hermetically sealed against humidity and other environmental contaminants without concern that the HDD component outgassing would poison the drive. This could allow an inert atmosphere (e.g., helium) to be maintained in the drive to lower power consumption, reduce disk vibration and flutter, or reduce chemical reactions on the disk. The use of the catalyst could also permit the use of "dirtier" components, reducing manufacturing costs. Alternately, lifetime of a drive could be increased with the same quality and cleanliness of components presently used. The capacity of the catalyst would only be limited by the surface area, which could comprise a great portion of the interior illuminated

Product Information

DUPONT

Rynite® PET

thermoplastic polyester resin

Rynite® 530 NC010

Rynite® 530 NC010 is a 30% glass reinforced modified polyethylene terephthalate with outstanding balance of strength, stiffness, and toughness, excellent electrical properties, surface appearance, and chemical resistance.

Property	Test Method	Units	Value
Mechanical			
Tensile Strength	ASTM D 638	MPa (kpsi)	
-40C (-40F)			214 (31.0)
23C (73F)			159 (23.0)
90C (194F)			83.4 (12.1)
150C (300F)			8.2 (8.19)
Elongation at Break	ASTM D 638	%	
-40C (-40F)			2.5
23C (73F)			2.7
90C (194F)			5.7
150C (300F)			6.5
Tensile Modulus	ASTM D 638	MPa (kpsi)	
-40C (-40F)			11300 (1640)
23C (73F)			10700 (1550)
90C (194F)			4540 (658)
150C (300F)			3090 (448)
Shear Strength	ASTM D 732	MPa (kpsi)	79.0 (11.5)
Poisson's Ratio			0.41
Flexural Modulus	ASTM D 790	MPa (kpsi)	
-40C (-40F)			10300 (1500)
23C (73F)			8960 (1300)
90C (194F)			3580 (520)
150C (300F)			2690 (390)

Contact DuPont for MSDS, general guides and/or additional information about ventilation, handling, purging, drying, etc.
Mechanical properties measured at 23°C (73°F) unless otherwise stated.
Shrinkage based on 76 X 127mm (3 X 5in) end-gated plagues.

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Rynite® 530 NC010

Property	Test Method	Units	Value
Mechanical			
Flexural Strength	ASTM D 790	MPa (kpsi)	
-40C (-40F)			269 (39.0)
23C (73F)			235 (34.0)
90C (194F)			114 (16.5)
150C (300F)			75.8 (11.0)
Compressive Strength	ASTM D 695	MPa (kpsi)	227 (33.0)
Deformation Under Load	ASTM D 621	%	
23C (73F), 27.6MPa (4000psi)			0.4
50C (122F), 27.6MPa (4000psi)			1.6
Flexural Fatigue	ASTM D 671	MPa (kpsi)	
23C (73F), Cycles 10E6			40.7 (5.9)
Flexural Creep Strain	ASTM D 2990	%	
23C (73F), 27.6MPa (4000psi)			0.56
60C (140F), 27.6MPa (4000psi)			1.18
125C (257F), 27.6MPa (4000psi)			1.65
Izod Impact	ASTM D 256	J/m (ft lb/in)	
-40C (-40F)			96 (1.8)
23C (73F)			101 (1.9)
Unnotched Impact	ASTM D 4812	J/m (ft lb/in)	
-40C (-40F)			750 (14.0)
23C (73F)			960 (18.0)
Thermal			
Heat Deflection Temperature	ASTM D 648	°C (°F)	
0.45MPa (66psi)			247 (477)
1.8MPa (264psi)			224 (435)
CLTE, Flow	ASTM E 831	E-4/K (E-4/F)	
-40 to 23C (-40 to 73F)			0.22 (0.12)
23 to 55C (73 to 130F)			0.10 (0.06)
55 to 160C (163 to 320F)			0.04 (0.02)
CLTE, Transverse	ASTM E 831	E-4/K (E-4/F)	
-40 to 23C (-40 to 73F)			0.67 (0.37)
23 to 55C (73 to 130F)			0.81 (0.45)
55 to 160C (163 to 320F)			1.07 (0.59)
Melting Point	ASTM D 3418	°C (°F)	254 (489)
Thermal Conductivity	ASTM C 177	W/m K (Btu in/h ft2 F)	0.29 (2.0)
Electrical			
Surface Resistivity	ASTM D 257	ohm	1 E14
Volume Resistivity	ASTM D 257	ohm cm	1 E15
Dielectric Strength, Short Time	ASTM D 149	kV/mm (V/mil)	
23C (73F), 500V/s, in oil, 1.6mm (0.062in)			25.5 (650)
23C (73F), 500V/s, in oil, 3.2mm (0.125in)			20.5 (520)
95C (200F), 500V/s, in oil, 1.6mm (0.062in)			22.5 (570)
95C (200F), 500V/s, in oil, 3.2mm (0.125in)			16.5 (420)
150C (300F), 500V/s, in oil, 1.6mm (0.062in)			15.5 (395)
150C (300F), 500V/s, in oil, 3.2mm (0.125in)			12.0 (300)

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Mechanical properties measured at 23°C (73°F) unless otherwise stated.
Shrinkage based on 76 X 127mm (3 X 5in) end-gated plagues.

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Rynite® 530 NC010

Property	Test Method	Units	Value
Electrical			
Dielectric Strength, Step by Step	ASTM D 149	kV/mm (V/mil)	
3.2mm (0.125in)			17.5 (445)
Dielectric Constant	ASTM D 150		
1E3 Hz			3.6
1E6 Hz			3.5
Dissipation Factor	ASTM D 150		
1E3 Hz			0.005
1E6 Hz			0.012
Arc Resistance	ASTM D 495	s	120-180
CTI	UL 746A	V	250-400
Flammability			
UL94 Rating at Min. Thickness	UL94		HB
UL94 Min. Thickness Tested	UL94	mm (in)	0.8 (0.032)
Limited Oxygen Index	ASTM D 2863	%	20
High Amperage Arc Ignition Resistance	UL 746A	arcs	60-120
High Voltage Arc Tracking Rate		mm/min	25-80
Hot Wire Ignition	UL 746A	s	>120
Temperature Index			
Temperature Index, Electrical	UL 746B	°C	
0.81mm (0.032in)			140
Temperature Index, Mechanical with Impact	UL 746B	°C	
0.81mm (0.032in)			140
Temperature Index, Mechanical without Impact	UL 746B	°C	
0.81mm (0.032in)			140
Other			
Specific Gravity	ASTM D 792		1.56
Hardness, Rockwell	ASTM D 785		
Scale M			95
Scale R			120
Coefficient of Friction	ASTM D 1894		
Self, static			0.18
Steel, static			0.17
Taber Abrasion		mg	
CS-17 Wheel, 1kg, 1000 cycles			30
Water Absorption	ASTM D 570	%	
50%RH,23C,24h			0.05
Mold Shrinkage		%	
Flow, 1.57mm (0.062in)			0.18
Flow, 3.2mm (0.125in)			0.25
Transverse, 1.57mm (0.062in)			0.78
Transverse, 3.2mm (0.125in)			0.80
Processing			
Melt Temperature Range		°C (°F)	280-300 (535-570)
Mold Temperature Range		°C (°F)	>95 (>205)
Drying Time, Dehumidified Dryer		h	4
Drying Temperature		°C (°F)	120 (250)
Processing Moisture Content		%	<0.02

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Mechanical properties measured at 23°C (73°F) unless otherwise stated.
Shrinkage based on 76 X 127mm (3 X 5in) end-gated plagues.

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Product Information

DUPONT

Rynite® PET

thermoplastic polyester resin

Rynite® 520 NC010

Rynite® 520 NC010 is a 20% glass reinforced modified polyethylene terephthalate with a good balance of strength, stiffness, specific gravity, and toughness with good surface appearance.

Property	Test Method	Units	Value
Mechanical			
Tensile Strength	ASTM D 638	MPa (kpsi)	
-40C (-40F)			148 (21.5)
23C (73F)			114 (16.5)
90C (194F)			58.6 (8.5)
150C (300F)			41.4 (6.0)
Elongation at Break	ASTM D 638	%	
-40C (-40F)			2.1
23C (73F)			2.3
90C (194F)			6.0
150C (300F)			7.0
Tensile Modulus	ASTM D 638	MPa (kpsi)	
-40C (-40F)			8280 (1200)
23C (73F)			7240 (1050)
90C (194F)			3370 (488)
150C (300F)			2090 (303)
Poisson's Ratio			0.40
Flexural Modulus	ASTM D 790	MPa (kpsi)	
-40C (-40F)			7950 (1100)
23C (73F)			6480 (940)
90C (194F)			2690 (390)
150C (300F)			1870 (271)
Flexural Strength	ASTM D 790	MPa (kpsi)	
-40C (-40F)			200 (29.0)
23C (73F)			172 (25.0)
90C (194F)			90.3 (13.1)
150C (300F)			55.9 (8.1)

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Mechanical properties measured at 23°C (73°F) unless otherwise stated.
Shrinkage based on 76 X 127mm (3 X 5in) end-gated plagues.

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Rynite® 520 NC010

Property	Test Method	Units	Value
Mechanical			
Compressive Strength	ASTM D 695	MPa (kpsi)	172 (25.0)
Izod Impact	ASTM D 256	J/m (ft lb/in)	
-40C (-40F)			53.4 (1)
23C (73F)			69 (1.3)
Unnotched Impact	ASTM D 4812	J/m (ft lb/in)	
-40C (-40F)			385 (7.2)
23C (73F)			510 (9.5)
Thermal			
Heat Deflection Temperature	ASTM D 648	°C (°F)	
0.45MPa (66psi)			240 (465)
1.8MPa (264psi)			210 (410)
CLTE, Flow	ASTM E 831	E-4/K (E-4/F)	
-40 to 23C (-40 to 73F)			0.31 (0.17)
23 to 55C (73 to 130F)			0.25 (0.14)
55 to 160C (163 to 320F)			0.11 (0.06)
CLTE, Transverse	ASTM E 831	E-4/K (E-4/F)	
-40 to 23C (-40 to 73F)			0.72 (0.40)
23 to 55C (73 to 130F)			0.93 (0.52)
55 to 160C (163 to 320F)			0.90 (0.50)
Electrical			
Dielectric Strength, Short Time	ASTM D 149	kV/mm (V/mil)	
23C (73F), 500V/s, in oil, 1.6mm (0.062in)			25.0 (635)
23C (73F), 500V/s, in oil, 3.2mm (0.125in)			20.0 (510)
95C (200F), 500V/s, in oil, 1.6mm (0.062in)			22.5 (570)
95C (200F), 500V/s, in oil, 3.2mm (0.125in)			17.5 (445)
150C (300F), 500V/s, in oil, 1.6mm (0.062in)			14.5 (375)
150C (300F), 500V/s, in oil, 3.2mm (0.125in)			11.5 (295)
Dielectric Constant	ASTM D 150		
1E3 Hz			3.2
1E6 Hz			3.0
Dissipation Factor	ASTM D 150		
1E3 Hz			0.010
1E6 Hz			0.015
Arc Resistance	ASTM D 495	s	300-360
CTI	UL 746A	V	175-250
Flammability			
UL94 Rating at Min. Thickness	UL94		HB
UL94 Min. Thickness Tested	UL94	mm (in)	0.8 (0.032)
High Amperage Arc Ignition Resistance	UL 746A	arcs	60-120
High Voltage Arc Tracking Rate		mm/min	80-150
Hot Wire Ignition	UL 746A	s	>120
Temperature Index			
Temperature Index, Electrical	UL 746B	°C	
0.79mm (0.031in)			140
Temperature Index, Mechanical with Impact	UL 746B	°C	
0.79mm (0.031in)			140
Temperature Index, Mechanical without Impact	UL 746B	°C	
0.79mm (0.031in)			140

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Rynite® 520 NC010

Property	Test Method	Units	Value
Other			
Specific Gravity	ASTM D 792		1.47
Hardness, Rockwell	ASTM D 785		
Scale M			90
Scale R			120
Mold Shrinkage		%	
Flow, 1.57mm (0.062in)			0.23
Flow, 3.2mm (0.125in)			0.35
Transverse, 1.57mm (0.062in)			0.82
Transverse, 3.2mm (0.125in)			0.90
Processing			
Melt Temperature Range		°C (°F)	280-300 (535-570)
Mold Temperature Range		°C (°F)	>95 (>205)
Drying Time, Dehumidified Dryer		h	4
Drying Temperature		°C (°F)	120 (250)
Processing Moisture Content		%	<0.02

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